IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application. An identifier indicating the status of each claim is provided.

Listing of Claims

1. (Currently Amended) A movable robot apparatus comprising:

safety level status detecting means for detecting a safety level status;

safety level detecting means for detecting a safety level of said safety level status detected by said safety level status detecting means,

wherein the safety level of the detected safety level status is determined by comparing the detected safety level status to a plurality of threshold values and grouping the detected safety level status as a function of the comparison result,

wherein the safety level is a volume calculated as a function of a joint angle, a capability of the joint angle, a timing of a potential risk, and a planned action, and the volume is calculated as the area of one of a plurality of safe space definition circles,

wherein the plurality of safe space definition circles include a safe space definition circle which contacts with a first link and a second link of one or more joint mechanisms, and a safe space definition circle which has a radius being a distance between the movable robot apparatus and an obstacle and a center being the movable robot apparatus; and

control means for performing a control process so as to implement prescribed countermeasures according to said safety level status detected by said safety level status detecting means and said safety level detected by said safety level detecting means,

wherein when the safety level increases, corresponding to a different safety level status, while the countermeasures are performed, the control means determines whether to maintain current countermeasures.

2. (Previously Presented) The robot apparatus according to claim 1,

wherein a safe space is defined so as to correspond to each safety level status to be detected by said safety level status detecting means; and

said safety level detecting means detects said safety level of said safety level status based on a volume of the safe space corresponding to the safety level status detected by said safety level status detecting means.

3. (Original) The robot apparatus according to claim 1,

wherein said control means performs said control process so as to implement said countermeasures according to a position of said safety level status detected by said safety level status detecting means and said safety level of the safety level status.

4. (Previously Presented) The robot apparatus according to claim 3,

wherein said control means performs said control process so as to implement different countermeasures depending on whether said position of said safety level status is in an upper body or a lower body of said robot apparatus.

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5. (Original) The robot apparatus according to claim 1,

wherein a priority is previously set according to a position of said safety level status and/or said safety level of the safety level status; and

said control means, when said safety level status detecting means newly detects a safety level status with a higher priority while said control process to implement said countermeasures is performed, changes the control process so as to implement countermeasures against the safety level status newly detected.

6. (Currently Amended) A control method of a movable robot apparatus, comprising:

a first step of detecting a safety level status and detecting a safety level of the safety level status detected;

determining the safety level of the detected safety level status by comparing the detected safety level status to a plurality of threshold values and grouping the detected safety level status as a function of the comparison result,

wherein the safety level is a volume calculated as a function of a joint angle, a capability of the joint angle, a timing of a potential risk, and a planned action, and the volume is calculated as the area of one of a plurality of safe space definition circles,

wherein the plurality of safe space definition circles include a safe space definition circle which contacts with a first link and a second link of one or more joint mechanisms, and a safe space definition circle which has a radius being a distance between the movable robot apparatus and an obstacle and a center being the movable robot apparatus; and

a second step of performing a control process so as to make said robot apparatus implement prescribed countermeasures according to said safety level status detected and said safety level detected,

wherein when the safety level increases, corresponding to a different safety level status, while the countermeasures are performed, the control means determines whether to maintain current countermeasures.

7. (Original) The control method according to claim 6,

wherein: safe space is defined so as to correspond to each safety level status; and in said first step, said safety level is detected based on a volume of the safe space corresponding to the safety level status.

8. (Original) The control method according to claim 6,

wherein, in said second step, said control process is performed so as to make said robot apparatus implement said countermeasures according to a position of said safety level status detected and said safety level detected.

9. (Original) The control method according to claim 8,

wherein, in said second step, said control process is performed so as to make said robot apparatus implement different countermeasures depending on whether said position of said safety level status is in an upper body or a lower body of said robot apparatus.

10. (Original) The control method according to claim 6,

wherein a priority is previously set according to a position of said safety level status and/or said safety level of the safety level status; and in said second step, when a safety level status with a higher priority is newly detected while said control process to make said robot apparatus implement said countermeasures is performed, the control process is changed so as to make the robot apparatus implement countermeasures against the safety level status newly detected.

11. (Currently Amended) A movable robot apparatus comprising:

safety level status detecting means for detecting a safety level status; and

control means for performing a control process so as to implement prescribed countermeasures according to a position of said safety level status detected by said safety level status detecting means,

wherein the position of the detected safety level status is determined by comparing the detected safety level status to a plurality of threshold values and grouping the detected safety level status as a function of the comparison result,

wherein the safety level is a volume calculated as a function of a joint angle, a capability of the joint angle, a timing of a potential risk, and a planned action, and the volume is calculated as the area of one of a plurality of safe space definition circles,

wherein the plurality of safe space definition circles include a safe space definition circle which contacts with a first link and a second link of one or more joint

mechanisms, and a safe space definition circle which has a radius being a distance between the

movable robot apparatus and an obstacle and a center being the movable robot apparatus,

        wherein when the safety level increases, corresponding to a different safety level

status, while the countermeasures are performed, the control means determines whether to

maintain current countermeasures.

        12. (Currently Amended) A control method of a movable robot apparatus,

comprising:

        a first step of detecting a safety level status; and

        a second step of performing a control process so as to make said robot apparatus

implement prescribed countermeasures according to a position of said safety level status detected

in said first step;

        determining the position of the detected safety level status by comparing the

detected safety level status to a plurality of threshold values and grouping the detected safety

level status as a function of the comparison result,

        wherein the safety level is a volume calculated as a function of a joint angle, a

capability of the joint angle, a timing of a potential risk, and a planned action, and the volume is

calculated as the area of one of a plurality of safe space definition circles,

        wherein the plurality of safe space definition circles include a safe space

definition circle which contacts with a first link and a second link of one or more joint

mechanisms, and a safe space definition circle which has a radius being a distance between the

movable robot apparatus and an obstacle and a center being the movable robot apparatus,

determining whether to maintain current countermeasures when the safety level increases, corresponding to a different safety level status, while the countermeasures are performed.

13. (Currently Amended) A robot apparatus having a plurality of movable units, comprising:

driving means for driving said movable units;

control means for controlling said driving means;

object detecting means for detecting an object;

action determination means for determining an action of said robot apparatus; and

safety level detecting means for detecting a safety level involving said object and said movable units,

wherein the safety level is a volume calculated as a function of a joint angle, a capability of the joint angle, a timing of a potential risk, and a planned action, and the volume is calculated as the area of one of a plurality of safe space definition circles,

wherein the plurality of safe space definition circles include a safe space definition circle which contacts with a first link and a second link of one or more joint mechanisms, and a safe space definition circle which has a radius being a distance between the robot apparatus and an obstacle and a center being the robot apparatus,

wherein said control means moves said movable units as a function of said safety level and said action determined by said action determination unit in order to mitigate or avoid danger,

wherein the action determined is a preprogrammed countermeasure corresponding to the detected safety level,

wherein when the safety level increases, corresponding to a different safety level status, while the countermeasures are performed, the action determination means determines whether to keep current countermeasures.

14. (Previously Presented) The robot apparatus according to claim 13,

wherein safe spaces are designated around the movable units.

15. (Currently Amended) A control method of a robot apparatus having a plurality of movable units, said control method comprising:

a first step of determining an action of said robot apparatus;

a second step of, when an object is detected, detecting safety level involving the object and said movable units,

wherein the safety level is a function of a capability of a joint angle, a timing of a potential risk, and available countermeasures; and

a third step of moving said movable units based on said safety level detected and said action determined to mitigate or avoid danger,

wherein the safety level is a volume calculated as a function of a joint angle, a capability of the joint angle, a timing of a potential risk, and a planned action, and the volume is calculated as the area of one of a plurality of safe space definition circles,

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wherein the plurality of safe space definition circles include a safe space definition circle which contacts with a first link and a second link of one or more joint mechanisms, and a safe space definition circle which has a radius being a distance between the robot apparatus and an obstacle and a center being the robot apparatus,

determining whether to keep the action when the safety level increases, corresponding to a different action, while the action is being performed.

16. (Previously Presented) The control method according to claim 15, wherein safe spaces are designated around the movable units.

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